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ABSTRACT

Both the trend toward the scientific information explosion and the trend toward equal opportunity of education are altering what we teach and how we teach. While the movement in research and development in education has been toward using systems applications to deal with these changes, there are some problems with this approach. The domain of academic policy is a far broader system than that to which systems analysis is typically applied, and it is likely that the long range goals which a systems analysis provides will conflict with the short-range political pressures of the situation. Also, systems concepts have evolved from industrial situations in which the organization is quite different from the decentralized, horizontally organized academic institutions with different goals. For example, the input-output model is probably too concrete for education if, as it is now thought, 70% of those entering school today will work in jobs that do not now exist. Further, systems planners should not forget the human element in any system, especially as it relates to the processes of accepting system improvements. Finally, it should be noted that while information systems may have become a widespread fad, even perfect information may not improve system performance. (SH)

SYSTEMS APPLICATIONS IN HIGHER EDUCATION: IMPLICATIONS FOR RESEARCH AND DEVELOPMENT

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I. Goals, Planning, and Management.

I think it is symptomatic of the problems we face today in Education that in a conference on education the session dealing with goals, planning and management comes last on the program. Historically, goals are those things which the public relations man prepared. One college president told me that if I had asked him a couple of years ago what his goals were, he would have responded, "To raise money." Today, he said, "I'm not sure."

We put more thought and effort into planning and operating a supermarket than we do in planning and operating a college campus. I am reminded of one new campus where the Board awarded contracts for the design and construction of the buildings before they hired a president and faculty. After all, I was told, everybody knows what a college campus should look like.

Traditionally, management has meant responding to the last crisis. While visiting a chancellor of a large university during a student riot that could be characterized by rock-throwing and vandalism, that spilled over into the neighborhood community, he lamented, "If they had only had a sit-in, that's what they did the last time, and we had a plan for that."

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The movement in research and development to use systems applications in education has probably stimulated more significant thinking in higher education than any other recent development. While I am very sympathetic to these developments and particularly to the projects described by the members of the panel, I shall try to present critical and contrasting views and suggest other alternatives for your consideration.

II. Educational Crisis.

Today, a wide array of scientific and social developments are reshaping our society and with it modern education. Two of the more significant trends are the (1) scientific information explosion and with it the rapid access to information, and (2) the trend toward equal opportunity of education. Both of these trends are altering what we teach and how we teach.

The body of scientific information is increasing exponentially and can be expected to double in the next 12 years. It is estimated that 90% of all the scholars who have contributed to the knowledge of mankind are alive today. New information has led to the creation of new professions and has made other professions obsolete. On graduation, one can expect to have up to three professions in a lifetime. It is estimated that of the children entering school today, 70% will work in occupations that do not now exist. This dynamic increase and expansion of knowledge has greatly affected what we teach.

Equal opportunity has altered out Nation's goal from providing education for the many to providing education for all. In the past, the

student came, the teacher taught and the student passed or failed. Now the student comes to learn and the school system passes or fails.

This trend has increased the stress on accountability in education. Given the new challenge, some say that education is failing; others say that we don't know how to teach. It is not that we don't know how to teach, but can we teach 40 students with a wide variety of backgrounds while permitting them to progress at their own individual pace, in inadequately designed buildings, with minimal materials for a cost-per-student-hour that is about what we pay a baby sitter? Like a bridge designed for certain stress loads, we can fail if our critical limit is exceeded. More times than not, it is the limit that is in question and not our ability.

As greater demands are placed upon education and as the costs continue to rise, it is only logical to look to other approaches. More recently, attention has been placed upon designing systems that permit teachers to effectively assist large numbers of students to attain specifiable levels of performance within acceptable cost limits.1/

III. System Applications.

In the papers presented today, four themes seem to emerge -- goals, models, accountability, and information.

(1) Goals

The frontiers of science and education are not always clear and distinct; they are frequently fuzzy, indistinct and constantly changing. Education through its decentralized organization and privileges of academic freedom permits

independence of thought and encourages diversity of opinion. In this way, education has been responsive to changes in science and information. If a junior staff member does not agree with existing thought he is free to express himself. Through publications he can change current thinking and channel thought into new directions. While this diversity of views is the strength of higher education, it is also one of its greatest weaknesses. While through the mechanism of academic freedom individual excellence is permitted to emerge through a competition of ideas, this same mechanism may inhibit the achievement of institutional excellence. No matter what the evidence or how effective the change, the choice to adopt it is up to the individual and he is just as free to accept good ideas and reject bad ones as he is to accept bad ideas and reject good ones.

Edward Gross and Paul Grambsch in their book, University Goals and Academic Power, found in a survey of goals of faculty and administrators that the goal of protecting the faculty academic freedom was at the head of the list. Goals related to students receive relatively little emphasis among these groups.2/

However, we must not mistake the high value placed on divergence of views as a lack of goals. Efforts to bring

about consensus through social pressure, Delphi techniques or group confrontations may yield consensus and destroy the strength and flexibility of academic institutions.

It has been said that systems analysis is the application of logical thinking to broad policy issues. The domain of politics, including academic policy, is a far broader system than that to which systems analysis is typically applied. James Schlesinger says systems analysis is applied to substantive issues, susceptible to definitions, where linkages exist among costs, technologies and closely related pay-offs.3/ He says that the criterion is usually substantive and presumably has a measurable utility. The contribution of systems analysis is its ability to take a long view and to disregard prior commitments if they are too costly or non-productive.

By contrast, he says, in politics one is concerned with more than substantive costs and benefits involved in a specific decision area; one is engaged in mobilizing support by word and actions over a wide range of ill-defined issues. The focus of political action is the short run.

Administrators of an academic institution must mobilize the support of faculty, students, trustees, legislators and the general public as well as devise rational effective procedures

for managing a large, complex organization.

In many cases the results of systems analysis will be in conflict with the political pressures of the situation. It is as important to consider the political domain as well as its logical sub-systems if systems techniques are to yield meaningful results. More times than not, it is this conflict between these domains that create the most difficult problems.

(2) Models

I am fond of pointing out that higher education is one of those rare cases where the whole is less than the sum of the parts. I offer this only to emphasize the decentralized character of higher education.

Systems concepts have evolved primarily from industry, defense and space projects. Caution must be exercised when concepts derived from centralized, line-staff organizations are applied to decentralized, horizontally organized academic institutions with different goals.

A case-in-point is the assumption that the input-output model is appropriate for education. In a reaction to line budgets and incremental funding, education has tacitly accepted the input-output model. One might question whether this is an appropriate model for education. Are there other models that

would yield different results? In any analysis the choice of the model may determine the outcome, consequently it is advisable to consider other models to determine if they yield similar results.

Let's explore one such model. If the information explosion is changing education; if of those entering school today, 70% on graduation will work in jobs that do not now exist; if individuals will have several professions in a lifetime, it is clear that a static model of education is not appropriate. The future is uncertain and in the face of uncertainty, the best strategy to follow is one that maximizes the alternatives available to the student so that when he reaches a choice-point in life he will have the skills and information necessary to cope with the future. In this probabilistic model we are more concerned with evolving a long-term strategy for an individual with changing goals in a dynamic world than defining concrete objectives in a static world. We would be more concerned with the consequences of a student not being exposed to certain concepts and skills than our ability to state behavioral objectives and to specify the discrete bits of information necessary to reach them in some minimal time period.

In selecting the model you may also fix the outcome. The famous last words of the system planner is "this is merely a plan, it is not laid concrete." It is usually said while mixing two parts sand with one part cement. Complex models, whether they be management information systems, computer-managed instruction systems or information retrieval systems, are not easily changed. As we increase flexibility we also increase costs. Therefore, we should give careful thought to the consequences of selecting a given model.

Another concern with the input-output model is performance criteria. The models described are based upon immediate criteria rather than ultimate criteria. Rosenstein and Cromwell point out that curricula must be designed to assist the student to face problems which will occur some time in the future.[4/] Existing curriculum seldom keeps pace with current knowledge. In an analysis of the University of California at Los Angeles engineering curriculum they found little correspondence between the types of engineers being graduated and regional and national employment needs. They found a high amount of redundancy within the curriculum and noted that Hooke's Law had been taught seven times and each time as though it had not been taught before. Rosenstein and Cromwell feel that a dynamic curricula must be provided with feedback on a regular two-year basis. They recommend that

surveys of the practicing professions should be conducted with regional support to furnish the national career profile of practicing professionals and to allow local correlations between career profiles of an institution's graduates and the effectiveness of past curricula. Finally, they say that 3% to 4% of faculty time should be devoted to research upon the quality control of the educational product. They propose computer programs be kept for storage and retrieval of all curriculum information.

(3) Accountability

Joseph Ben-David has said that excellence in science as in other things consists of so many aspects that one prefers the judicial procedure where every case has to be separately argued on its own merits to the application of one or several quantifiable measures for comparison of a great many cases.5/

There is a great deal of concern and resistance to the concept of accountability in education. If there is a legitimate divergence of views in education, how can we devise standards for accountability?

There are two important aspects to the concept of accountability; one is blame and the other is an auditable set of procedures to assure acceptable results. The important characteristic of a system is not that one part is better than another but that

the final product or outcome meets acceptable performance specifications. In education, while we stress individual excellence, we seldom build in quality control techniques. More frequently, accountability is a means for assessing blame. Only when we remove the blame element from the concept of accountability and substitute control mechanisms through the use of auditable procedures will we improve the overall quality of education.

We must be aware of the human element in any system. In any analysis there are characteristic phases of resistance that most of us go through before we tend to consider positive alternatives and accept system improvements.

Whenever a system problem occurs in which we are involved the first phase of resistance is to insist that there is no problem and any facts simply are not true. After it has been demonstrated that there is a problem and the facts are true the second phase of resistance is to accept it but to say "it is not my fault." We insist that if others had done their jobs the problem would not have occurred. In the third phase, we accept responsibility and assume the role of martyr and say "all right, it was my fault, blame it on me." In the fourth phase, constructive suggestions begin to emerge. In the fifth stage, if the process is successful, agreement is reached on

how to handle the problems and acceptable procedures are established for detecting and coping with similar problems in the future. It seems unproductive to waste so much time on blame and resistance; system planners, however, must be aware of this process and devise methods that tend to reduce the blame factor.

IV. Information.

Russell Ackoff says that the preoccupation with information systems has become a widespread fad.[6] Some feel that if enough data are stored in a data bank and administrators can draw from it "on-line" and "in real-time" all problems will vanish. Ackoff says that this belief is based on three false assumptions. First, it assumes administrators suffer from a lack of relevant information and from an excess of irrelevant information. He says examination will show most administrators suffer from an information overload and cannot cope with it and as a consequence they tend to develop procedures which are less information-dependent. In order to get administrators to use information, we must provide less information by filtering and condensing it and make it more relevant and timely. The second false assumption is that if administrators were provided all the information they want the effectiveness of their decisions would improve. There are many situations where no amount of information will help in reaching an effective decision. Third, most information system designers assume that improved communications will improve organizational performance. Ackoff says good communications can produce bad performance if the structure of

the organization is deficient. These criticisms are equally applicable when applied to instructional systems. In summary, information is but one sub-system and even perfect information may not improve system performance.

V. Specific Reactions.

Dr. Ben Lawrence of the Western Interstate Commission for Higher Education (WICHE) described in his paper, "Cooperative Development of Planning and Management Systems in Higher Education", efforts to develop a dictionary of common data elements. While this may seem trivial to many, it is a significant step forward in higher education.

The failure of many Federal, state and local programs to assist education can be attributed to our inability to adequately identify and specify the problem due to a lack of data or comparative information. Without a reliable, valid data base, it is not possible to take advantage of such system techniques as modeling, optimization and simulation.

Probably the greatest impact of the WICHE effort has been on the Federal government. In the past the Federal government has required higher education to provide information for a countless array of uncoordinated surveys which contained a wide variety of poorly specified terms. Now major efforts are being made to coordinate these surveys and to insist upon compatible dictionary terms.

Dr. Lyman Glenny of the University of California, Berkeley, pointed out in his paper, "State Government and Control of Higher Education", the

challenges from State Legislatures and proprietary schools to the apparent uncoordinated activities of higher education. With the rising demand for education and the limited human and financial resources, this challenge signals the danger associated with not considering cooperative efforts.

Dr. Alexander Shure of the New York Institute of Technology offers us in his paper, "Computer'Based Systems in Higher Education", a management system for administering instruction to a large group of students on an individual basis while assuring measurable performance standards. There are several cautions with respect to this model. It assumes that we can arrive at a consensus as to what our learning objectives are. This is usually true at the information level, but there are many components in education which are heuristic and do not readily lend themselves to the formulation and management by objective. The model tends to accept the "little-steps-for-little-feet", stimulus-response approach to education. There are other approaches that have been experimentally demonstrated to be effective.[7,8] Operant approaches assume that we learn better by considering the total context and relating facts to principles. This approach would not conveniently fit into the computer-managed instruction approach to education. While results can be produced by both approaches, the learner should have the choice of selecting the learning style.

Dr. Oscar Mink of the Regional Education Laboratory of the Carolinas and Virginia stresses in his paper, "The System Approach and Organization Development", the importance of the outside catalyst to assist in developing management skills. Most educators reach their management positions by

excelling in their respective disciplines. Somewhere, training and information must be provided if we are to have good administrators.

Another critical point made by Dr. Mink is the one of incentives. Just as a teacher reinforces the desired performance of his student and inhibits that which is not desired, so the administrator must provide incentives to the faculty to increase efficiency, effectiveness and productivity. Faculty members obtain prestige by writing journal articles which produce esteem by members of their discipline. It is easier to receive promotion by changing institutions than by remaining indefinitely in one institution. Consequently, the most significant psychological and monetary rewards come from sources external to the institution. Until universities and colleges significantly reward instructors for the quality of their teaching or the number of students produced it will be difficult to improve education.

VI. Summary.

In the past, by not seriously considering goals, objectives and evaluation, we have meandered down many roads. There is an adage that says that if you don't know where you're going any road will lead you there. Today, system concepts have stimulated anew our concern for where we are going and how best to get there.

FOOTNOTES

1. Andrew R. Molnar. "Media and Cost-effectiveness," ANALOG/HYBRID Computer Educational Users Group Transactions. October, 1970

2. Edward Gross and Paul V. Grambsch. University Goals and Academic Power. (Washington, D.C., The American Council on Education, 1968)

3. James R. Schlesinger. "Systems Analysis and the Political Process," The Journal of Law and Economics, The University of Chicago Law School, October, 1968

4. Allen B. Rosenstein and Leslie Cromwell. "Dynamic Analysis and Design of Engineering Curricula - The Information Base." Department of Engineering, University of California, Los Angeles, California, June 1968

5. Joseph Ben-David. "Fundamental Research and The Universities -- Some Comments on International Differences. (Paris: Organisation for Economic Co-operation and Development, 1968)

6. Russell L. Ackoff. "Efficiency in Resource Utilization in Education," (Paris: Organisation for Economic Co-operation and Development, 1969)

7. Andrew R. Molnar. "The Computer and Curriculum Analysis," (Paris: O.E.C.D., Centre for Educational Research and Innovation, 1970)

8. Andrew R. Molnar. "Computer-Based Instruction and the Knowledge Society," at the Computer in Education Conference at the Centro Studi e Applicazioni in Tecnologie Avanzate, Universita Degli Studi Di Bari, Bari, Italy, October 1970